TRIPLETT

# INSTRUCTION MANUAL

MODEL 602 TYPE 3
AUTO POLARITY
MICRO POWER V-O-M

MP MASTER
MA26296

# INSTRUCTION MANUAL

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# MODEL 602 TYPE 3

# MICRO POWER V-O-M

TRIPLETT CORPORATION
BLUFFTON, OHIO 45817

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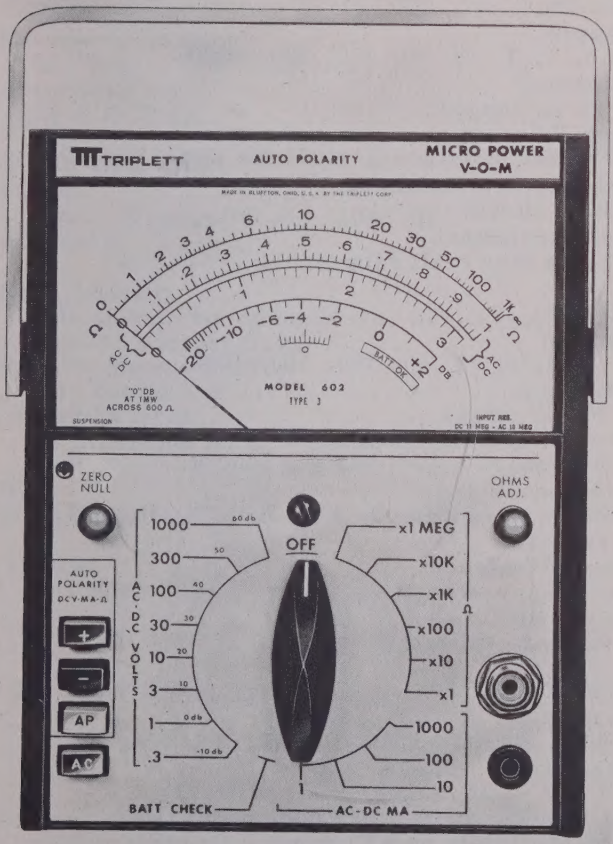
TRIPLETT
AUTO POLARITY
MICRO POWER
V-O-M
MADE IN BLUFFTON, OHIO, U. S. A. BY THE TRIPLETT CORP.
Ω
AC
DC
"0" DB
AT 1MW
ACROSS 600Ω
MODEL 602
TYPE 3
SUSPENSION
BATT OK
DB
INPUT RES.
DC 11 MEG - AC 10 MEG
ZERO
NULL
OHMS
ADJ.
AUTO
POLARITY
DCV-MA-Ω
AP
AC
A.C.-D.C. VOLTS
1000
300
100
30
10
3
1
.3
60 db
50
40
30
20
10
0 db
-10 db
OFF
Ω
x1 MEG
x10K
x1K
x100
x10
x1
1000
100
10
1
BATT CHECK
AC-DC MA

# SPECIFICATIONS

DC VOLTS

Ranges:
.3, 1, 3, 10, 30, 100, 300, 1000.

Accuracy:
3% all ranges.

Auto Polarity:
Pointer indicates up scale for either polarity.

Polarity Determination:
Push Button + or - .

Input Resistance:
11.12 Meg - All ranges.

AC VOLTS

Ranges:
.3, 1, 3, 10, 30, 100, 300, 1000.

Accuracy:
3% all ranges.

Frequency Compensation:
All ranges except 300 and 1000 V.

Frequency Range:
20 Hz to 10 kHz .3, 1.0, 3.0, 10, 30, 100 ranges.

Input Resistance:
10 Meg - All ranges.

Detection:
Average calibrated in RMS.

OHMMETER

Ranges:
RX1, RX10, RX100, RX10K, RX1 Meg.

Open circuit voltage:
1.5 V - All ranges.

Max. power applied to device under test:
57 Milliwatts on RX1 range. On other ranges the power is correspondingly less.

Center scale:
10 Ohms.
Measurement Range:
.2 Ohms to 1000 Megohms.
Accuracy:
3% of DCV arc.

CURRENT (AC, DC)
Ranges:
1 mA, 10 mA, 100 mA, 1000 mA.
Accuracy:
4%.
Auto Polarity:
Pointer deflects up scale with either positive or negative current flow.
Polarity Determination:
Push button + or - .
Circuit IR Drop:
316 Millivolts on all current ranges.

METER
20 uA Suspension.

BATTERIES

| | |
|---|---|
| 2 - 9 V Neda 1604 | Eveready (Carbon-Zinc) 216 |
| | Burgess (Carbon-Zinc) 2U6 |
| | Mallory (Alkaline) M-1604 |
| | Mallory (Mercury) TR146X |
| 1 - 1 1/2 V USASI"D" | Eveready (Carbon-Zinc) 950 |
| | Burgess (Carbon-Zinc) AL-2 |
| | Mallory (Alkaline) Mn-1300 |

CONSTRUCTION

Black molded high impact plastic case; outside dimensions 3 3/16" x 5 1/8" x 6 1/2" with metal handle that can be used to place instrument on approximately 25° angle. Anodized aluminum panel.

WEIGHT

Approximately 2 1/2 pounds with batteries.

ACCESSORIES supplied with Model 602

1 Probe Assembly
1 Ground Lead
2 Alligator Clips
3 Batteries 2 - 9 V, 1 - 1 1/2 V

ACCESSORIES AVAILABLE

| | |
|---|---|
| Leather Carrying Case | Part No. 10-1793<br>Model 639-OS |
| High Voltage Probe | Part No. 79-270 |
| RF Probe | Part No. 79-330 |

## GENERAL DESCRIPTION

The Model 602 is a new concept in Solid State V-O-M's. If offers several advantages over conventional V-O-M's. The first is Auto Polarity. This feature saves the user valuable time. For example, in measuring current, polarity is usually of little importance; connections can therefore be made very quickly without regard for polarity. Measuring battery voltage is another good example; polarity need not be known for this check. When troubleshooting, most of the time the polarity of the voltages to be measured is known and therefore this type of V-O-M can be used to make measurements more quickly. Auto Polarity eliminates the need for continually switching the leads.

The Model 602 Type 3 features a new Micro-Power circuit with a current drain so low that if the tester is left on continuously, the life of the batteries will be approximately equivalent to self life.

Another advantage is that the same amplifier is used for all functions, ACV-DCV-current and resistance measurements. This cost savings is passed on to the user in a lower selling price.

Since the same amplifier is used for AC and DC functions, input resistance is high for both. Sensitivity of .3 V full scale is the same for ACV and DCV.

The amplifier incorporates a high degree of feedback and therefore both AC and DC meter tracking scales are linear. Only two voltage scales are used for all AC-DC current and voltage ranges. This is a great time saving feature that makes the tester easy to use. Also because of feedback, meter moving coil copper changes, with temperature, are automatically com-

pensated. Thus the tester can be used over a wide temperature range 32° to 120° F without loss of accuracy.

When in Auto Polarity the indicator is not adjusted for zero as in conventional meters. The Model 602 is adjusted for minimum indication. This means that a zero adjust can be made from an angle because the operator merely adjusts for a minimum indication, and therefore parallax of the pointer can be neglected. This is another time saving feature.

## PREPARING THE INSTRUMENT FOR USE

Unpack the Model 602 and visually inspect the unit to make certain no damage was incurred during shipment. If damaged, report immediately to local Triplett distributor or service station.

To derive most benefit from this instrument it is recommended that the operator or user read the instruction manual in its entirety before attempting to use the instrument. This is particularly important with this unit because the principles of operation are somewhat different than conventional V-O-M's.

## BATTERY CONDITION INFORMATION

The tester uses two types of batteries, a D cell for resistance measurements and two 9 Volt batteries for the amplifier circuit. The condition of the 9 Volt batteries is given when the range switch is positioned to "Batt Test". Depress the + polarity switch to check the condition of B2 and the - polarity switch to check the condition of B3. The indicator pointer should fall into the area of the "Batt OK" or above on the meter dial.

The D cell condition is determined when the range switch is set to any of the resistance ranges and the zero and full scale adjustments are made. If the D cell is low, the Ohms Adjust pot will not be capable of positioning the pointer to full scale.

In addition to the above check on the D cell the following test should be performed whenever the resistance readings are suspected of being erroneous.

## BATTERY CONDITION INFORMATION (cont'd.)

A resistor of known value between 5 to 10 ohms should be checked occasionally on the X1 range. If the reading is low, the D cell should be replaced as this indicates higher than normal internal resistance in the battery which will subtract from the meter reading.

## BATTERY INSTALLATION

Battery Types 1 - "D" Cell, 2 - 9 Volt Neda 1604

1. Unpack batteries and visually inspect for damage or leakage.

2. Remove back case by loosening thumb screw at rear and pulling apart.

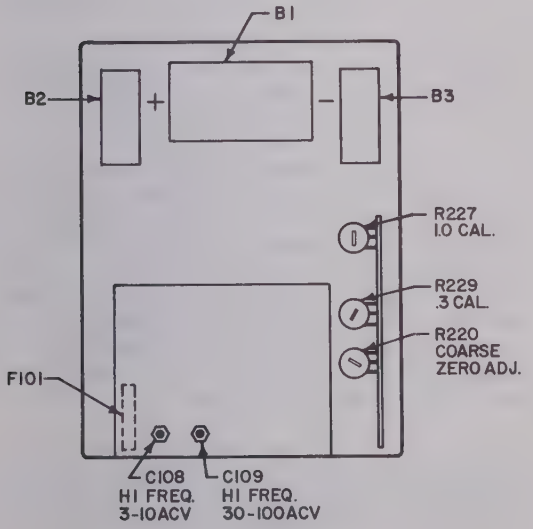


Fig. 1
Battery and Cal. Control Location

3. Install D cell, observing polarity as indicated in Fig. 1.

4. Install two 9 Volt batteries, first snap battery terminal to batteries and then insert into side pockets as illustrated in Fig. 1.

5. Re-install in rear case.

6. Test for condition of batteries as outlined above.

7. Turn range selector to OFF position. Check mechanical zero of pointer. If off, adjust with screw driver by turning zero adjust screw located below window in the center of the tester.

8. Adjust the range switch to 300 V and the function push button to AP. Adjust the ZERO control. The pointer will reach a minimum point when the ZERO control is slowly rocked back and forth. The minimum reading should fall at, or near, zero. If it does not, the mechanical zero is incorrectly set. Reset mechanical zero and re-adjust ZERO. An alternative zero adjustment is to depress + or - button and adjust ZERO control for zero.

9. The tester should now be ready for use.

10. For more detailed instructions on pointer zeroing refer to the Calibration Maintenance Section.

## THEORY OF OPERATION

### DC FUNCTIONS

The operation of the circuit is as follows:

Refer to schematic of Fig. 5. With the AP push button depressed the circuit is set up for DC Volts, DC current and Ohms. In DC Volts, the input voltage is applied to the top of the resistive voltage divider R102 to R108. Switch 101 picks off a divided voltage (depending on where the range selector is set) and applies it to the RC filter R213 and C203. The function of the filter is to remove any AC that may be superimposed on the DC voltage being measured.

The output of the filter is applied to R214 and CR-201. The purpose of this network is to provide overload protection to the input field-effect transistor. The voltage applied to Q201 is amplified and applied to Q203 for additional amplification. The complimentary emitter followers Q204 and Q205 prevent loading of Q203 by the bridge and feedback network. At zero or null Q204 and Q205 are non-conducting, which is a contributing factor to the low current consumption of the instrument. On positive signals Q205 conducts. On negative signals Q204 conducts.

The output of Q204 and Q205 is applied to the full wave bridge CR-203, CR-204, CR-205 and CR-206 which gives unidirectional current flow through the meter regardless of polarity.

To determine what polarity is being measured, the plus or minus switches are operated. This indication is as follows. If a positive voltage is ap-

plied to input, the meter will give an up scale reading. If the positive button is depressed the reading remains the same. If the negative button is depressed the indication falls to below zero. The reverse is true for a negative polarity.

The return of the bridge is connected to the input stage source resistors. This feedback stabilizes the gain of the circuit and makes the output linear.

## AC VOLTS CIRCUIT

With the AC push button depressed the AC voltage to be measured is applied to the input frequency compensated divider R102 to R108. Coupling capacitor C102 is also switched in series to block any DC voltage. The RC filter R213 and C203 is switched out of the circuit on AC. The amplifier and bridge circuit operates the same as AP. The detection of the bridge is full wave average and the meter is calibrated in RMS. Feedback is accomplished the same as in AP. Due to this feedback the AC measurements are very linear down to 1% of scale.

## RESISTANCE MEASUREMENT CIRCUITS

Unlike conventional V-O-M's where the test leads are reversed to change polarity, the Model 602 reverses the battery when reverse polarity is needed.

The ohms battery (D cell) is reversed when the negative polarity button is depressed. With neither polarity button depressed the battery is connected so that a positive polarity is applied to the red test probe. When positive polarity button is depressed there is no change, the polarity remains positive to red test probe.

The amplifier is utilized for resistance measurements. The negative or common terminal is connected through the fuse to one side of the ohms battery. The red test probe is connected through any one of the R102 to R108 resistors (depending on resistance range used) to the other side of the battery.

The red test probe is also connected to the FET amplifier. Thus with the test leads open the battery potential of 1 1/2 volts is applied to the input of the amplifier. Normally the meter would deflect beyond full scale, however, in the resistance position of the range selector the amplifier is de-sensitized to 1 1/2 V full scale. This is accomplished by altering the feedback network R25 to R30. The ohms adjust control R25 is part of this network. It is adjusted so that the pointer rests at full scale.

With the test leads shorted together the 1 1/2 V potential is shorted out, and the pointer falls to zero.

It should be remembered that in the open position,

any one of the R102 to R108 resistors is in series with the battery and input of the amplifier. Thus when the resistance to be measured is equal to the range resistor the voltage is divided in half to .75 volts and the indicator would fall to half scale. Thus the scale is calibrated in this manner. The smallest range resistor thus determines the minimum center scale value. In this case it is 10 Ohms.

The maximum power dissipated in the resistor under test for each ohms range is given in the following chart.

| OHMS RANGE | POWER |
|---|---|
| X1 | 57 mW |
| X10 | 5.7 mW |
| X100 | 570 μW |
| X1K | 57 μW |
| X10K | 5.7 μW |
| X1 Meg. | .057 μW |

## OPERATION

### DC VOLTAGE MEASUREMENTS

1. Slide switch on red probe body to DCV.

2. Switch range selector to desired DCV range.

3. Depress push button labeled AP for Auto Polarity.

4. Zero - short test leads together and adjust Zero control for a minimum indication of pointer which should be zero if the mechanical zero is correctly set. The Zero control should be rocked back and forth around zero to obtain an absolute minimum reading.

5. Connect test leads across voltage to be measured. The pointer will indicate up scale regardless of polarity. If reading is below 1/3 scale set range selector to next lower range. If beyond full scale adjust range selector to higher range.

6. Determining Polarity - push either + or - push button. If reading remains, the polarity to the red probe is that of the push button depressed.

   If the reading falls to below zero the opposite polarity is present.

Note - Zero Center Measurements, .3, 3.0, 30, 300 ranges only. Depress + button and adjust Zero control for mid scale indication.

## RESISTANCE MEASUREMENTS

1. Set slide switch on probe body to Ω.

2. Depress AP push button for Auto Polarity.

3. Set range selector to 300 Volts position. Make zero adjustment (same as in DC Volts).

4. Set range selector to desired resistance range (open test leads).

5. Adjust ohms adjust control for full scale or ∞ indication.

6. Place test leads across resistor to be measured. Take reading and multiply reading by range multiplier. For example, if range selector is set to RX1K and reading is 50 then value of resistor is 50,000 ohms.

7. Note - In RX1 position of range selector, when the test leads are shorted together the instrument will measure the resistance of the test leads about .5 ohms. Under no circumstances should the operator attempt the Zero Null adjustment with the leads shorted together on the RX1 range. An error in measurement will result.

   The proper procedure for making a resistance measurement in the RX1 position is as follows: Make Zero adjustment in the 300 DCV position or higher

ohms ranges such as RX1K with the test leads shorted. Return range selector to RX1, short leads and note reading about .5 ohms. Place test leads across resistor to be measured. Note reading and mentally subtract initial reading (.5 ohms) from final indication to obtain true resistance reading.

8. Polarity - the Model 602 is designed to apply a positive voltage to the red probe, in the Auto Polarity position. If the + button is depressed the polarity remains the same, positive to red probe. If the - minus button is depressed the ohms battery is reversed and a negative voltage appears at the red probe with respect to the black lead.

## CURRENT MEASUREMENTS

1. Set slide switch on red probe to mA.

2. Set range selector to desired current range.

3. Depress AC push button for AC current measurements or AP for DC current measurements.

4. Zero meter (as in step 4 of DC Volts).

5. Connect to current source to be measured. If reading is below 1/3 scale, set range selector to next lower range, if beyond full

CURRENT MEASUREMENTS (cont'd.)

scale set to higher range.

6. Polarity - if measuring DC current and polarity needs to be determined, depress + or - button and observe indicator.

In the current measurement mode the amplifier is used to measure the voltage developed across the current shunts R109 to R112. The shunts are designed for a 316 mV drop for a full scale indication, thus the amplifier has a 316 mV sensitivity for all current ranges AC or DC.

AC VOLTAGE MEASUREMENTS

1. Set slide switch on probe body to ACV.

2. Depress AC push button.

3. Set range selector to desired ACV range (short test leads together).

4. Zero meter (as in step 4 of DC Volts).

5. Connect test leads to voltage to be measured. If reading is below 1/3 scale set range selector to next lower range. If beyond full scale adjust range selector to higher range.

## DB MEASUREMENTS

1. Set up as in making voltage or current measurements.

2. Read dB scale and add to range selector dB marking.

The range selector and scale designations are based on a reference of 1 Milliwatt across 600 Ohms and 0 dB is equal to .776 Volts. The range selector steps are designed for a ratio of 3.16 or 10 dB per step.

For impedance other than 600 Ohms, refer to dB Correction Chart.

This meter is capable of direct dB measurements by direct addition of range and dial dB readings. Example: If the meter scale is at -4 dB and the range at +10 dB the level is +6 dB. If the range is at -10 dB with the same -4 dB on the meter the level is -14 dB, again by direct addition of range and scale readings. Both AC and DC dB measurements can be made in this manner.

The following formula can be used to convert the dB reading into watts:

$$P_{(watts)} = (1 \times 10^{-3}) \text{ antilog } (dB/10)$$

$$P_{(mw)} = \text{antilog } (dB/10)$$

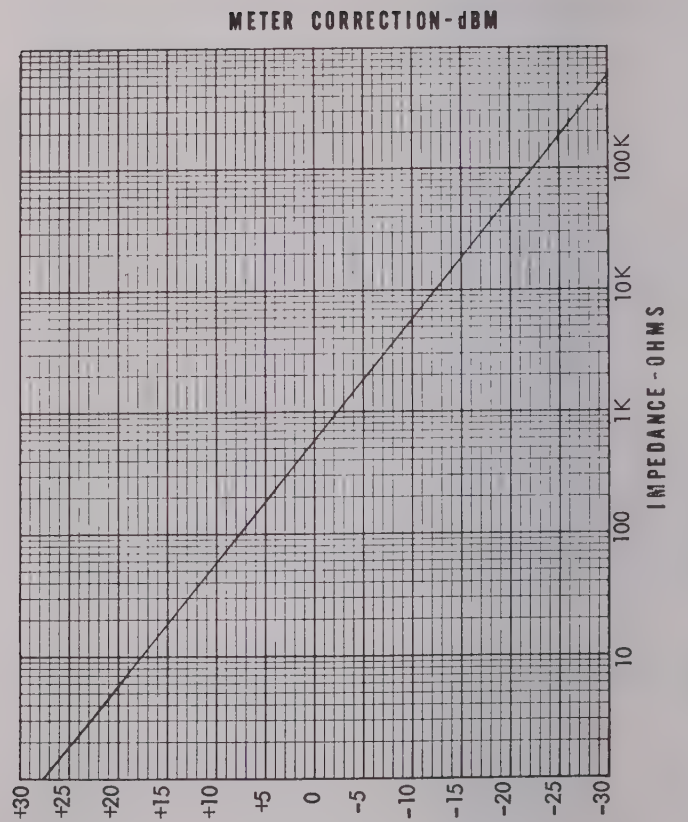


Fig. A DB Correction Chart

## CALIBRATION - MAINTENANCE

This section contains testing and service information. Periodic routine maintenance required by the Model 602 is replacement of batteries.

## REPAIR OR SERVICE

In the event repair or service is required and it is necessary to return the unit to the factory, please outline the nature of the difficulty. By providing this information, Triplett can supply more efficient service.

## INOPERATIVE UNIT

Should your Model 602 become inoperative, the first recommended step is a battery check. This is given in the Battery Installation Section. One can also use a V-O-M and check all batteries individually.

## FUSE

The fuse located on PC Board shown on Fig. 1 as F101 is electrically placed in series with the negative test lead. Thus it is most likely to blow (due to overloads) when using the current or ohms ranges. When blown, the input becomes open, although the DC ZERO, the amplifier and OHMS ADJ. will remain functional. A spare fuse is located below B1 1.5 V battery, in a depression behind meter.

## REQUIRED TEST EQUIPMENT FOR CALIBRATION

1. DC voltage source .3 V to 1 kV with accuracy of 0.5%.

2. DC current source 1 mA to 1 A with accuracy of 0.5%.

3. AC voltage source .3 V to 1 kV with accuracy of 0.5% (60 or 400 Hz).

4. AC transfer standard, to produce accurate voltages over frequency range of 10 Hz to 10 kHz with output of .3 to 100 Volts at .05% accuracy.

## MECHANICAL ZERO ADJUSTMENT

1. Turn instrument off.

2. Rotate meter adjustment screw, located below meter face until pointer indicates zero exactly.

## ELECTRICAL ZERO ADJUSTMENT

1. Set push button switch to AP and range selector switch to 1 Volt.

2. Rotate ZERO control on front panel to clockwise stop.

3. Adjust COARSE ZERO CONTROL R220 (screw driver adjust on PC board, see

ELECTRICAL ZERO ADJUSTMENT (cont'd.)

Fig. 1) for a reading of .3 on the 0-1 scale.

4. Rotate ZERO control on front panel to CCW stop and note difference between this reading and the reading in step 3.

5. Adjust COARSE ZERO CONTROL R220 half this difference in the direction of .3.

6. Check adjustment by rotating ZERO control into both stops. Re-adjust R220 as necessary to give the same deflection for both extremes of the ZERO control.

DC VOLT - DC CURRENT CALIBRATION

1. Set range selector switch to .3 DCV, push button switch on AP, and probe switch to DCV.

2. Short test leads together and adjust ZERO control for exact zero meter indication.

3. Apply .3 DCV and adjust R229 (screw driver adjust on PC Board, see Fig. 1) for full scale indication of 3.0 (this adjustment calibrates .3, 3.0, 30, 300 AC-DC ranges).

4. Apply 1.0 DCV and adjust R227 (screw driver adjust on PC Board, see Fig. 1) for full scale indication of 1.0 (this adjustment calibrates 1.0, 10, 100, 1 kV AC-DC ranges).

## DC VOLT - DC CURRENT CALIBRATION (cont'd.)

5. Check all ranges by applying full scale voltages.

6. Set probe switch to mA position, set range selector switch to current ranges. Check all ranges by applying full scale currents. Calibration of this circuit should not be required, since it is a function of .3 DCV calibration and fixed shunts.

## AC VOLT CALIBRATION

1. Set probe switch to AC, push button switch AC, range selector switch to 300 Volt range. Short test leads, adjust ZERO NULL control on front panel for zero meter indication.

   Calibration of this circuit should not be required, since the same basic amplifier and calibration adjustments are used for both AC and DC ranges. However, if re-calibration on ACV ranges is desired, please note following:

   .3, 3.0, 30, 300 AC-DC ranges - Adjust R229
   1.0, 10, 100, 1 kV AC-DC ranges - Adjust R227

2. Set range switch to 3 ACV. Using a transfer standard, obtain a reference indication near full scale at a frequency of approximately 60 Hz. Apply the exact same magnitude of signal at 10 kHz and adjust C108 until meter indication is exactly the same as the reference reading. See Fig. 1 for location of trimmer.

AC VOLT CALIBRATION (cont'd.)

3. Set range switch to 30 ACV. Using a transfer standard, obtain a reference indication near full scale at a frequency of approximately 60 Hz. Apply the exact same magnitude of signal at 10 kHz and adjust C109 until meter indication is exactly the same as the reference reading.

OHMS RANGES

There is no calibration required for ohms ranges. The unit may be checked for proper function, as follows:

1. Set slide switch on probe to OHMS position. Push button switch on AP, range selector switch to 300 DCV range.

2. Adjust ZERO control on front panel for zero meter indication.

3. Turn range selector switch to X1 ohms range. With test leads open, rotate OHMS ADJ. control on front panel for exact full space meter reading or ∞ indication.

4. Check each range at 1/2 scale (10 ohms or multiple of 10 ohms depending on range setting) using following 0.5% resistors:

| | |
|---|---|
| X1 range = 10 Ohm | X1K range = 10 k |
| X10 range = 100 Ohm | X10K range = 100 k |
| X100 range = 1 k | X1M range = 10 Meg. |

# ACCESSORY - LEATHER CARRYING CASE

LEATHER CARRYING CASE

CASE, MODEL 639-OS
Part No. 10-1793

Black leather case, has built-in stand on back. Flaps open to permit use of tester in case. Compartment for accessories. For use with 600 series testers. Felt lined. Leather strap handle.

## WARRANTY

The Triplett Corporation warrants instruments manufactured by it to be free from defective material or factory workmanship and agrees to repair or replace such instruments which under normal use and service, disclose the defect to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing or replacing any instrument or test equipment which proves to be defective, when returned to us transportation prepaid, within ninety (90) days from the date of original purchase.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons or service stations in any way so as, in our judgment to injure their stability or reliability or which have been subject to misuse, negligence or accident or which have had the serial number altered, effaced, or removed. Neither does this warranty apply to any of our products, which have been connected, installed, or adjusted otherwise than in accordance with the instructions furnished by us. Accessories including all vacuum tubes and batteries not of our manufacture used with this product are not covered by this warranty.

The Triplett Corporation reserves the right to discontinue models at any time, or change specifications, price or design, without notice and without incurring any obligation.

Upon acceptance of this material the purchaser agrees to assume all liability for any damages, and bodily injury which may result from the use or misuse of the material by the purchaser, his employees, or others and that the Triplett Corporation shall in-

cur no liability for direct or consequential damage of any kind.

Parts will be made available for a maximum period of five (5) years after the manufacture of this equipment has been discontinued. Parts include all materials, charts, instructions, diagrams, accessories, et cetera, which were furnished in the standard or special models.

This warranty and conditions of sale are in lieu of all others expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our products.

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